

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
4 November 2004 (04.11.2004)

PCT

(10) International Publication Number  
**WO 2004/094061 A1**

(51) International Patent Classification: **B02C 4/20**  
(21) International Application Number:  
PCT/GB2004/001652

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(22) International Filing Date: 16 April 2004 (16.04.2004)

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
0308933.1 17 April 2003 (17.04.2003) GB

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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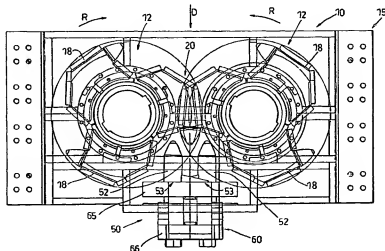
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Published:  
— with international search report

[Continued on next page]

(54) Title: **BREAKER BAR**



(57) Abstract: A mineral breaker bar assembly for a mineral breaker having at least one breaker drum assembly rotatably mounted in a housing, the breaker bar assembly having an elongate support body adapted for mounting on the mineral breaker housing and having a plurality of breaker teeth mounted on the elongate support body, each of the breaker teeth being adjustably mounted on the elongate support body to enable the height of each breaker tooth relative to the support body to be individually adjusted.



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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## BREAKER BAR

The present invention relates to a mineral breaker bar assembly and to a mineral breaker including such an assembly.

- 5 Mineral breakers are known housing a pair of mineral breaker drum assemblies rotatably mounted in a housing with a breaker bar located beneath the drum assemblies. An example of such a mineral breaker is described in our European patent specification 0246775.
- 10 With this type of mineral breaker, when mineral is deposited onto the drum assemblies, a first breaking action is performed as the mineral breaker drum assemblies rotate and direct the deposited mineral into and through an elongate passageway between the drum assemblies. As broken mineral flows out from beneath the passageway inbetween the drum assemblies, a
- 15 second breaking action is performed between the breaker bar and the breaker drum assemblies.

- According to one aspect of the present invention there is provided a mineral breaker bar assembly for a mineral breaker having at least one breaker drum
- 20 assembly rotatably mounted in a housing, the breaker bar assembly having an elongate support body adapted for mounting on the mineral breaker housing and having a plurality of breaker teeth mounted on the elongate support body, each of the breaker teeth being adjustably mounted on the elongate support body to enable the height of each breaker tooth relative to
- 25 the support body to be individually adjusted.

According to another aspect of the invention there is provided a mineral breaker having at least one breaker drum assembly rotatably mounted in a housing and including a breaker bar assembly as defined above.

Various aspects of the present invention are hereinafter described with reference to the accompanying drawings, in which:-

Figure 1 is an end view, partly broken away, of a mineral breaker according to an embodiment of the present invention;

5        Figure 2 is a plan view of the mineral breaker housing shown in Figure 1 with the breaker drum assemblies removed;

Figure 3 is a side view, partly broken away, of the housing shown in Figure 2;

Figure 4 is a perspective view from above of a breaker bar assembly  
10        according to an embodiment of the present invention;

Figure 5 is a perspective view from below of the breaker bar assembly shown in Figure 4;

Figure 6 is a plan view from above of the breaker bar assembly shown in Figure 4;

15        Figure 7 is a plan view from below of the breaker bar assembly shown in Figure 4;

Figure 8 is a sectional view taken along line VIII-VIII in Figure 7;

Figure 9 is a side view of the breaker bar assembly shown in Figure  
4;

20        Figure 10 is a side view of the breaker bar assembly of Figure 4 with all breaker teeth removed;

Figure 11 is a sectional view along line XI-XI in Figure 10;

Figure 12 is a perspective view from below showing a tooth and axial adjustment means of the breaker bar assembly of Figure 4;

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A mineral breaker 10 according to an embodiment of the present invention is illustrated in Figures 1 to 3. The mineral breaker 10 includes a pair of breaker drum assemblies 12 which are rotatably mounted within a housing  
15.

30

The breaker drum assemblies 12 each include a plurality of radially projecting breaker teeth 18. In use, the drum assemblies 12 are driven in contra-rotating directions, as indicated by arrow R, such that mineral deposited onto the drum assemblies from above, as indicated by arrow D, is  
5 acted upon by opposing teeth 18 on the drum assemblies 12 and caused to flow through a passageway 20. The passageway 20 defined inbetween the adjacent drum assemblies 12 and so is elongate and extends longitudinally along the length of the drum assemblies 12.

10 The teeth 18 on each breaker drum assembly 12 are preferably arranged in circumferentially extending groups of teeth with the groups being spaced along the axis of the drum assembly such that an annular gap is defined inbetween adjacent groups of teeth. In the illustrated embodiment, there are three teeth 18 in each group. It is envisaged that there may be more or less  
15 than three teeth 18 in each group.

The groups of teeth on respective drive assemblies 12 are staggered such that a group of teeth on one drum assembly is located opposite to an annular gap defined between two adjacent groups of teeth on the opposite drum  
20 assembly.

Preferably the drum assemblies 12 are mounted in the housing 15 with their longitudinal axes spaced apart to enable the teeth on one drum assembly to enter into the annular gaps on the opposed drum assembly 12.

25

The drum assemblies 12 may be, for example, constructed and arranged in accordance with those described in our European patent specifications 0167178, 0096706 or 0114725.

A breaker bar assembly 50 is located beneath the passageway 20 and includes a plurality of upwardly projecting breaker teeth 52 which co-operate with opposed breaker teeth 18 of respective breaker drum assemblies 12.

5

The teeth 52 are mounted on an elongate support body 60 which is mounted on the housing 15 so as to extend longitudinally in the longitudinal direction of the passageway 20; that is, in the longitudinal direction of the drum assemblies 12. The teeth 52 are arranged in two rows 53 of teeth wherein  
10 the teeth 52 in each row 53 are spaced longitudinally along the support body 60.

One row 53 of teeth 52 is arranged to co-operate with one drum assembly 12 and the other row 53 of teeth 52 is arranged to co-operate with the other  
15 drum assembly 12.

The spacing between teeth 52 in a given row 53 is such that an individual tooth 52 is positioned in alignment with an annular gap between adjacent circumferential groups of teeth 18 on the opposed drum assembly 12 with  
20 which it co-operates.

Thus as mineral flows downwardly out of the passageway 20, the flow is divided as the movement of the left-hand drum assembly 12 (Figure 1) causes the mineral to flow to the left-hand side of the breaker bar assembly  
25 and as the movement of the right-hand drum assembly 12 causes the mineral to flow to the right-hand side of the breaker bar assembly 50.

During such movement of the left-hand breaker drum assembly 12, the teeth 18 of that drum assembly are caused to sweep past the left-hand row 53 of

teeth 52 and similarly the teeth 18 on the right-hand drum 12 are caused to sweep past the right-hand row 53 of teeth 52.

5 The opposed teeth 18, 52 thereby act to further break down the size of mineral; the maximum size of mineral after such break down being determined by the amount by which each tooth 52 projects into the annular gap defined between the adjacent circumferential groups of teeth 18 with which it co-operates, viz. the greater the amount by which a tooth 52 projects into an annular gap, the smaller the reduction in size of mineral  
10 lumps emerging from the mineral breaker.

As illustrated in Figures 1 to 3, the support body 60 is fixedly mounted at each end onto the housing 15, preferably by bolts (not shown), passing through bolt holes 62 in the support body 60 and a housing ledge 16 upon  
15 which the support body 60 is seated. The support body 60 is thereby located at a fixed position relative to the housing 15.

In order to adjust the amount by which each tooth 52 projects into the opposed annular gap, each tooth 52 is adjustably mounted on the support  
20 body 60 such that the amount by which it projects above the support body 60 may be selectively adjusted. Accordingly it is possible to accurately determine the position of each tooth 52 and so ensure that the maximum lump size of mineral emerging from the mineral breaker is maintained at a desired maximum.

25

As best illustrated in Figures 4 to 12, the breaker bar assembly 50 preferably includes a support body 60 which comprises an upper elongate plate 65 which overlies a lower elongate plate 66. The upper and lower plates 65, 66 are spaced laterally apart and secured together by a series of plate-like webs  
30 68. Preferably a central web 70 is provided which extends longitudinally

along the elongate plates 65, 66 and also, laterally extending webs 72 are also provided. The position and number of webs 68 are chosen to provide the elongate body 60 with a desirable amount of strength for resisting the breaking forces experienced during breaking of mineral between opposed teeth 18, 52.

Preferably the plates 65, 66 and plate-like webs 68 are composed of the same or different suitable steels which are weldable together to enable the elongate support body 60 to be fabricated by welding the webs 68 to plates 65, 66.

The upper and lower plates 65, 66 are provided with aligned pairs of teeth accommodating bores 80, 81 respectively through which a tooth 52 is able to axially slide. Preferably as shown, each tooth 52 is of shaft-like form; that is, it has an elongate cylindrical body 152 of constant cross-section along its length. Its upper terminal end 253 is shaped, preferably in the shape of a cone, to define a tooth formation.

The bore 80 which accommodates the upper portion of the tooth body 152 is preferably dimensioned such that there is a close tolerance fit to thereby reduce to a minimum lateral movement between the tooth body 152 and the upper plate 65. If desired, it is envisaged that bore 80 may be defined by a bush inserted into plate 65.

To adjust the axial position of a tooth 52 relative to the support body 50, axial adjustment means 90 are provided. The adjustment means 90 preferably comprises a bolt 91 which is screw threadedly received in a threaded bore 92 extending axially along the tooth body 152 from its lower terminal end which is defined by a lower axial abutment face 153.

30



The bolt 91 has a bolt head 94 which abuts against lower face 166 of plate 66 and on tightening of the bolt 91 serves to draw abutment face 153 into abutment with the upper face 266 of the lower plate 66.

- 5    The size of bore 81 in lower plate 66 is preferably large enough to permit the elongate body 152 to pass therethrough. Accordingly, it is possible to insert the tooth 52 upwardly from a position below the breaker bar assembly 50 until the tooth 52 projects above the upper plate 65.
- 10   To set the axial position of the tooth 52, one or more packing members 98 are located inbetween the abutment face 153 and the upper face 266 of plate 66. The bolt 91 is then tightened to bring the abutment face 153 into tight abutment with the upper face 266 via the one or more packing members 98.
- 15   Each packing member 98 is preferably of generally U-shape to enable the packing member 98 to be inserted in a lateral direction relative to the bolt 91 and so enable it to be positioned between faces 153, 266 without requiring removal of the bolt 91.
- 20   Preferably, each packing member 98 has a cylindrical projection 99 on its lower face and a cylindrical seat 100 on its upper face to enable the packing members 98 to be stacked and to be inserted into bore 81 and receive the lower terminal end of the tooth without lateral play. Packing members 98 of different axial thickness may be used to enable the axial position of each
- 25   tooth to be accurately set at any desired position.

Preferably the bolt head 94 abuts against the lower face 166 of plate 66 via an annular packing member 198 and one or more washers 93. Preferably the washers 93 are Belville type washers which serve to also act to restrain

30   the bolt 91 against untightening rotation due to vibration during use.

Alternatively or in addition, anti-rotation means, such as a plastics insert, may be incorporated into the tooth body 152 to restrain unwanted untightening rotation of the bolt 91.

- 5 To prevent rotation of the tooth body 152 within the support body 50, a keyway 252 is preferably provided which extends longitudinally axially along the tooth body 152. The keyway 252 co-operates with a projection 353 which is formed on the upper plate 65. Optionally, an additional keyway 352 may be provided which enables the tooth 92 to be removed,
- 10 rotated and re-inserted for continued use. This is advantageous for extending the useable life of the tooth since, in use, it is expected that only the side of the tooth 52 facing opposed teeth 18 will be subjected to maximum wear.
- 15 Preferably, as seen in particular in Figure 4, strengthening collars 150 are provided for extending the axial extent of bores 68 and providing additional metal for resisting breaking forces experienced when teeth 52 co-operate with teeth 18 to break mineral. Preferably the collars 150 are fixedly secured to the upper plate 65 by welding.

20

The collars 150 illustrated in Figure 4 are generally frusto-conical in shape. However, it is envisaged that other shapes may be adopted.

### CLAIMS

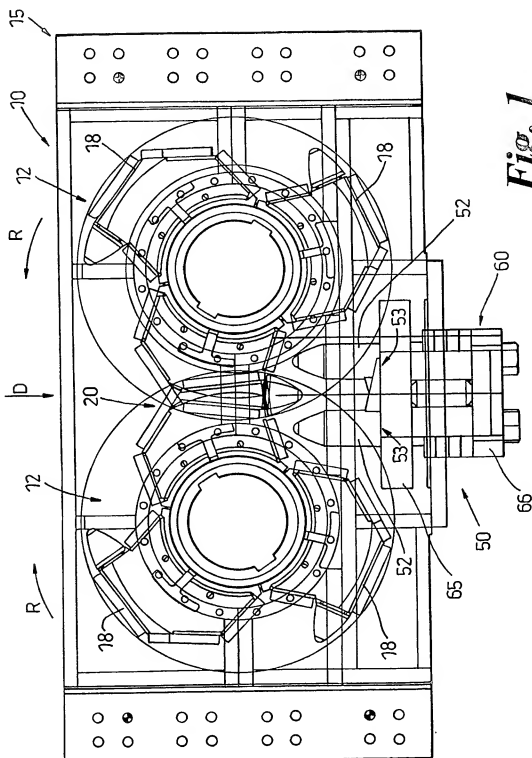
1. A mineral breaker bar assembly for a mineral breaker having at least one breaker drum assembly rotatably mounted in a housing, the breaker bar  
5 assembly having an elongate support body adapted for mounting on the mineral breaker housing and having a plurality of breaker teeth mounted on the elongate support body, each of the breaker teeth being adjustably mounted on the elongate support body to enable the height of each breaker tooth relative to the support body to be individually adjusted.
- 10 2. A breaker bar assembly according to Claim 1 wherein the support body comprises an upper elongate plate directly overlying lower elongate plate, the upper and lower plates being secured together and spaced laterally apart by at least one web.
- 15 3. A breaker bar assembly according to Claim 2 wherein said at least one web extends longitudinally in the longitudinal direction of the elongate support body.
- 20 4. A breaker bar assembly according to Claim 1, 2 or 3 wherein each tooth includes an elongate body having a tooth formation at one terminal end, the elongate body being axially slidably received in the support body to enable its longitudinal position relative to the support body to be adjusted.
- 25 5. A breaker bar assembly according to Claim 4 wherein each tooth is provided with axial adjustment means for lockingly locating the tooth at the desired longitudinal position relative to the support body.

6. A breaker bar assembly according to Claim 5 wherein the axial adjustment means is located at the axial end of the elongate body opposite to said one terminal end.
- 5 7. A breaker bar assembly according to any preceding claim when dependent on Claim 2 where the elongate body of each tooth is axially slidable through both the upper and lower plates.
8. A breaker bar assembly according to any preceding claim wherein  
10 each tooth is formed from an elongate bar of constant circular cross-section.
9. A breaker bar assembly according to Claim 8 wherein the elongate bar includes at least one keyway extending longitudinally along its length for co-operation with a projection on the support body to prevent rotation of  
15 the elongate bar relative to the support body.
10. A breaker bar assembly substantially as herein described with reference to and as illustrated in the accompanying drawings.
- 20 11. A mineral breaker having at least one mineral breaker drum assembly rotatably mounted in a housing and including a breaker bar assembly according to any preceding claim.
12. A mineral breaker according to Claim 11 including a pair of mineral  
25 breaker drum assemblies each having radially projecting breaker teeth, the drum assemblies being spaced laterally apart to define an elongate passageway therebetween through which mineral flows in a direction from above to below the mineral breaker drum assemblies as it is being broken down by said drum assemblies, the breaker bar assembly being located  
30 beneath said passageway and being arranged such that its support body

extends longitudinally in the longitudinal direction of the passageway and its breaker teeth co-operates with teeth on the mineral breaker drum assemblies to break mineral exiting from said passageway.

- 5 13. A mineral breaker substantially as herein described with reference to and as illustrated in the accompanying drawings.

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**Fig. 1**

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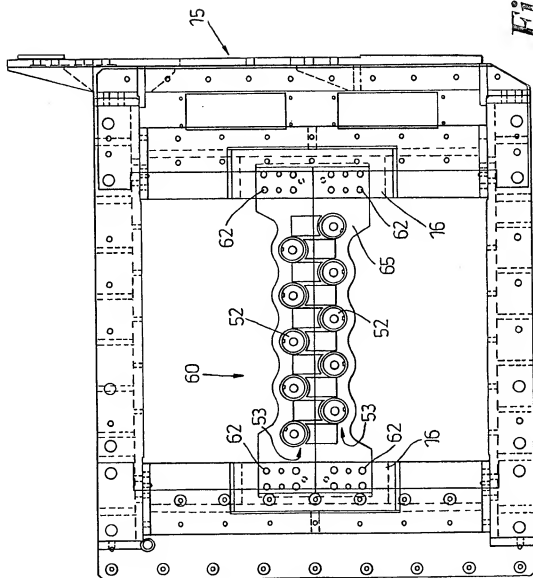
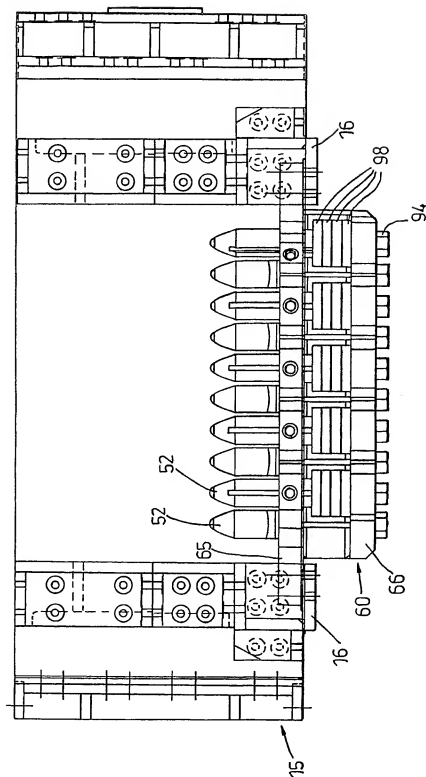


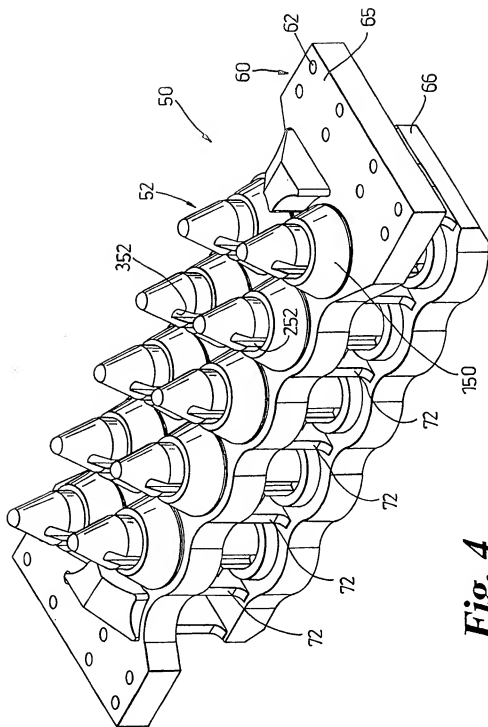
Fig. 2

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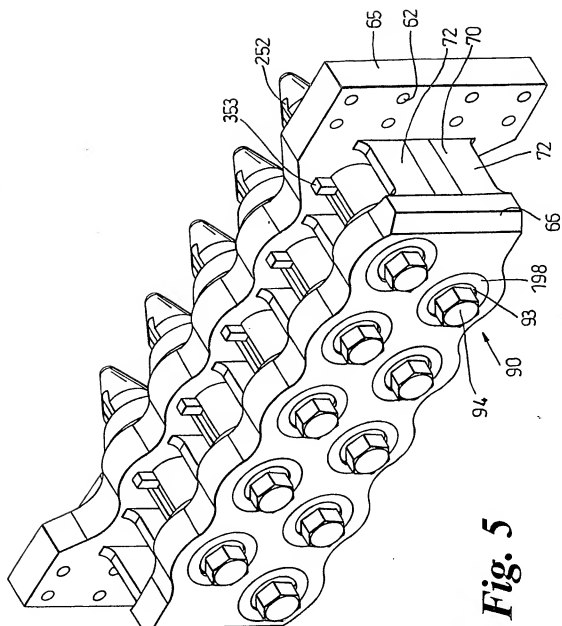
*Fig. 3*



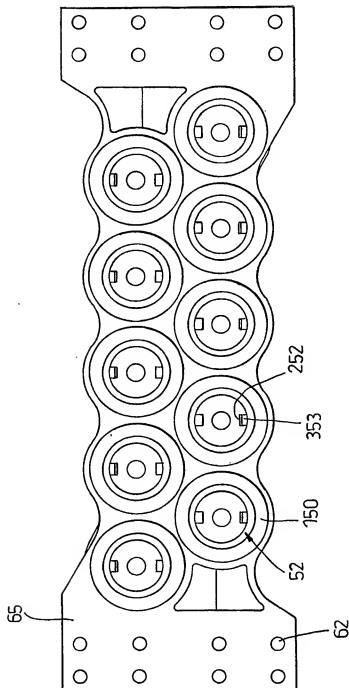
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**Fig. 4**

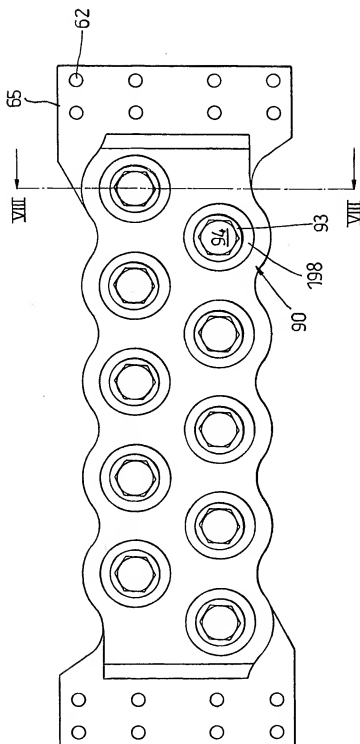
**5/11**



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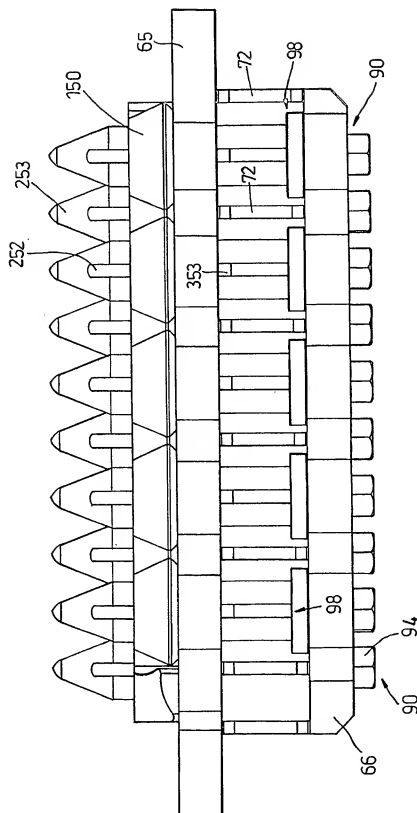


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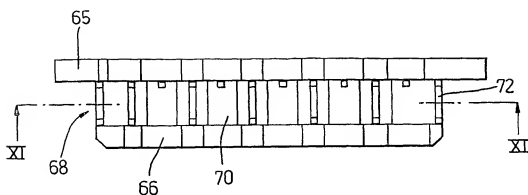
*Fig. 7*



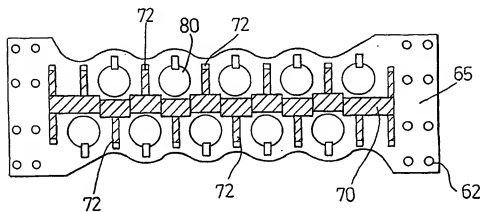
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*Fig. 9*

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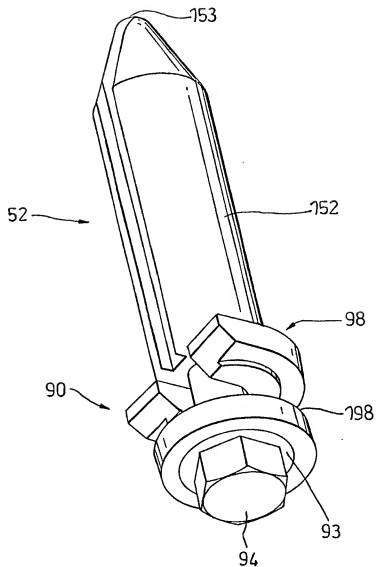


**Fig. 10**



**Fig. 11**

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*Fig. 12*



## INTERNATIONAL SEARCH REPORT

PCT /GB2004/001652

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B02C4/20

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B02C E21C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2 797 052 A (CLARK HARVEY N) 25 June 1957 (1957-06-25)	1,4-9,11
A	the whole document	12
A	DE 44 31 551 A (STEINBRECHER MICHAEL) 7 March 1996 (1996-03-07)	1-9,11, 12
A	DE 385 526 C (FUNK & ESCH) 24 November 1923 (1923-11-24)	1-9,11, 12
A	US 3 136 078 A (RENAULT JEAN C) 9 June 1964 (1964-06-09)	1-9,11, 12
	the whole document	
	----- -/-	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*E\* earlier document but published on or after the international filing date

\*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*A\* document member of the same patent family

Date of the actual completion of the international search

12 July 2004

Date of mailing of the international search report

29/07/2004

Name and mailing address of the ISA

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## INTERNATIONAL SEARCH REPORT

PCT/GB2004/001652

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 605 676 A (COMBUSTIBLES NUCLEAIRES STE IN) 29 April 1988 (1988-04-29) the whole document -----	1-9, 11, 12
A	US 5 318 351 A (WALKER RALPH L) 7 June 1994 (1994-06-07) the whole document -----	1-9, 11, 12
A	US 5 611 496 A (FLEENOR JEFF A) 18 March 1997 (1997-03-18) the whole document -----	1-9, 11, 12

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB2004/001652

## Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☒ Claims Nos.: 10, 13  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 10, 13

Since the subject-matter of claims 10, 13 is so unclear and since it consequently does not fulfil the Rule 6.2 (a) and Article 6 PCT, a meaningful search could not be carried out for these claims, and therefore according to Article 17.2 (a)(ii)(b) the International Search Report has not been established for claims 10, 13.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

PCT/GB2004/001652

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2797052	A	25-06-1957	NONE
DE 4431551	A	07-03-1996	DE 4431551 A1 07-03-1996
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US 3136078	A	09-06-1964	NONE
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US 5611496	A	18-03-1997	NONE